REGULARLY ACQUIRED REMOTE SENSING FOR NACP

NACP REMOTE SENSING MEETING

Univ of Montana

20 August 2004

Steven Running

University of Montana

Missoula, MT. USA

Initial Considerations

- **Time domains**
- **hourly**, for aircraft transect fluxes
- **daily** full-year to calculate seasonal carbon/water fluxes
- **annual** to relate to forest/crop/range inventory and harvest data
- **one-time**, to initialize models [ie landcover]

- **Spatial domains**
- Global for inversion modeling
- N. American full continent + coastal oceans
- Regional at Tier 1 flux sites

Disciplinary Domains

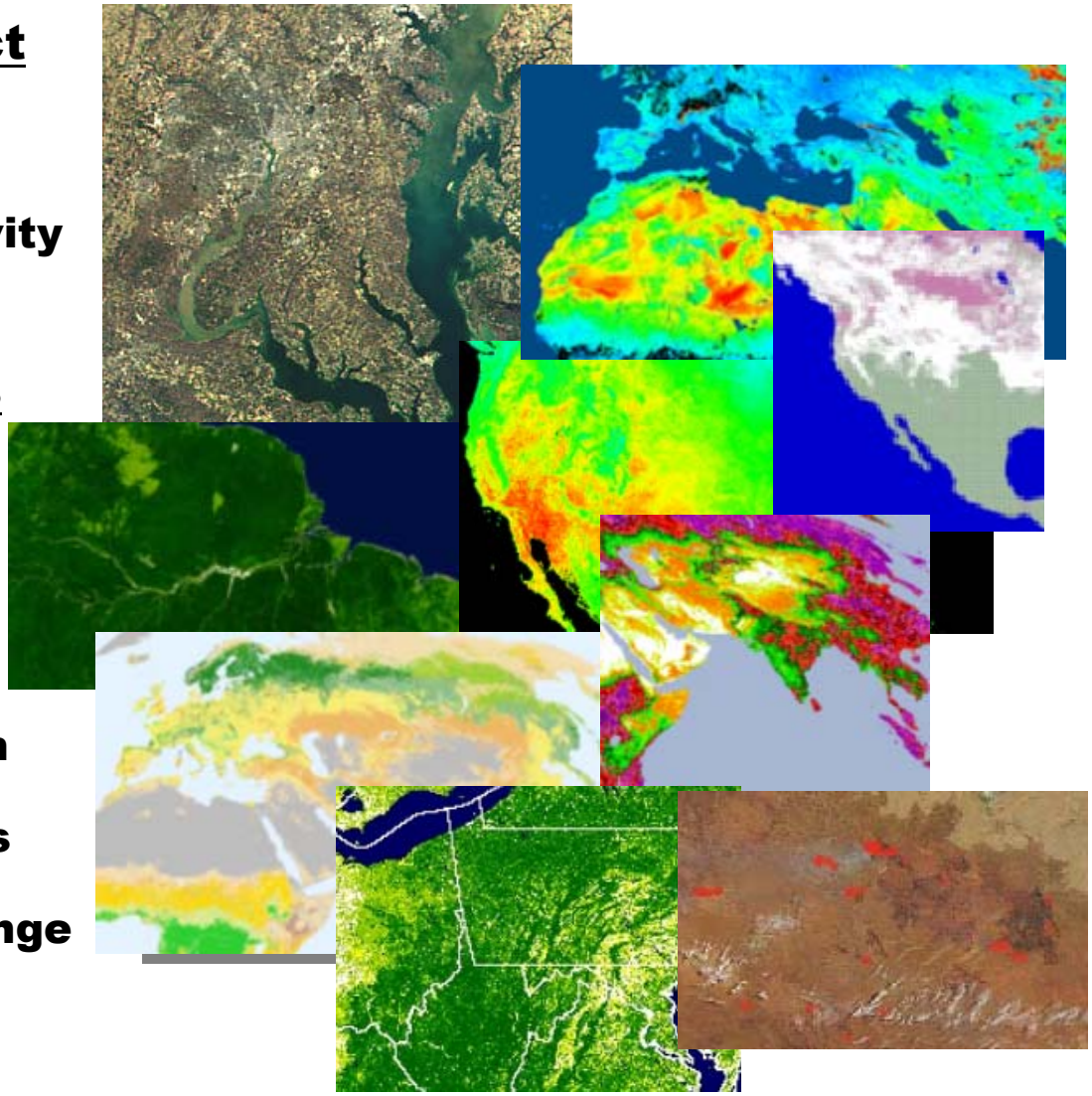
- Atmospheric, clouds, aerosols
- Trace gas chemistry
- Land, vegetation
- Hydrology
- Cryosphere, snow
- Freshwater, wetlands
- Coastal oceans, estuaries

Sensor Suites with Regular Data

- AMSR
- AMSU – CERES
- MOPITT
- GOES
- MODIS
- Landsat
- ASTER, MISR non-continuous data

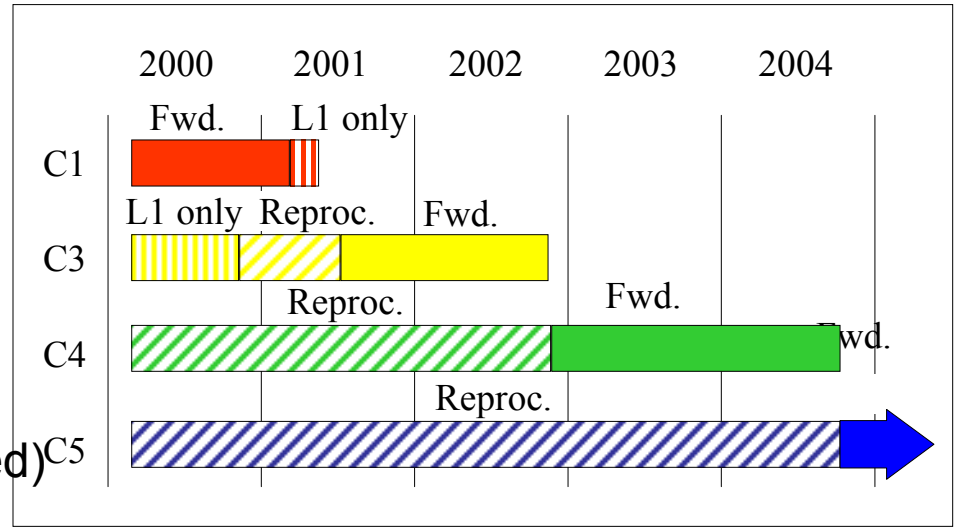
MODIS Land Products

- **Energy Balance Product Suite**
  - Surface Reflectance
  - Land Surface Temperature, Emmisivity
  - BRDF/Albedo
  - Snow/Sea-ice Cover
- **Vegetation Parameters Suite**
  - Vegetation Indices
  - LAI/FPAR
  - PSN/NPP
- **Land Cover/Land Use Suite**
  - Land Cover/Vegetation Dynamics
  - Vegetation Continuous Fields
  - Vegetation Cover Change
  - Fire and Burned Area

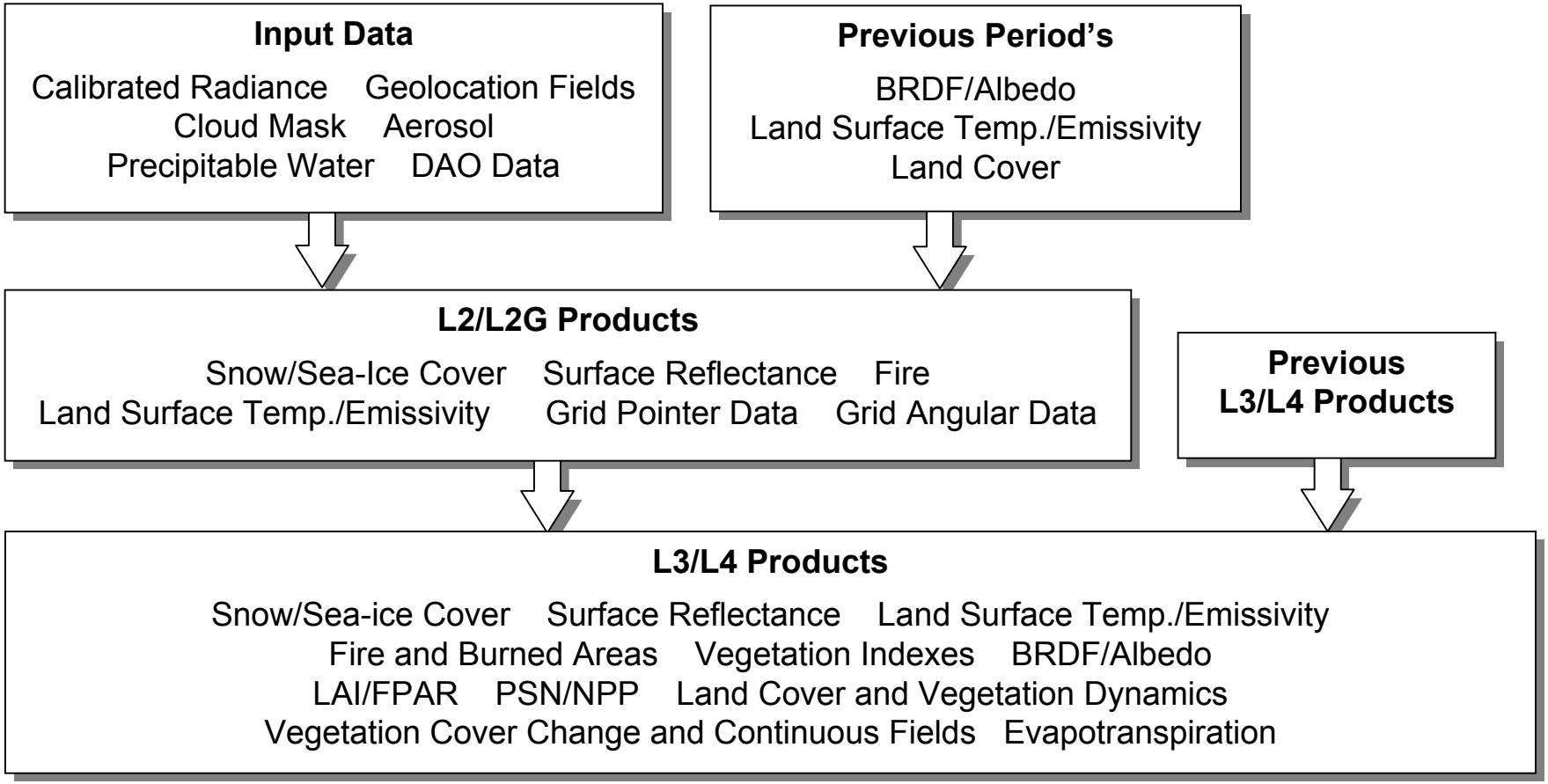


MODIS Terra Production and Distribution

- **Terra production commenced Feb. 2000**
- **Collection 1: "Beta"**
  - L1: Feb. '00 to May '01
  - L2+: Feb. '00 to Mar. '01
- **Collection 3: "Provisional"**
  - L1: Feb. '00 to Oct. '02 (from Nov. '00 onward validated)
  - L2+: Nov. '00 to Nov. '02
- **Collection 4: "Validated"**
  - Land forward processing: Started Jan. '01
  - Land/Atmosphere reprocessing at 3.6X: Feb. '00 to Nov. '02 (will finish Oct. '03)
- **Collection 5: will start Fall '04 (with Terra)**



Land Algorithm Dependency



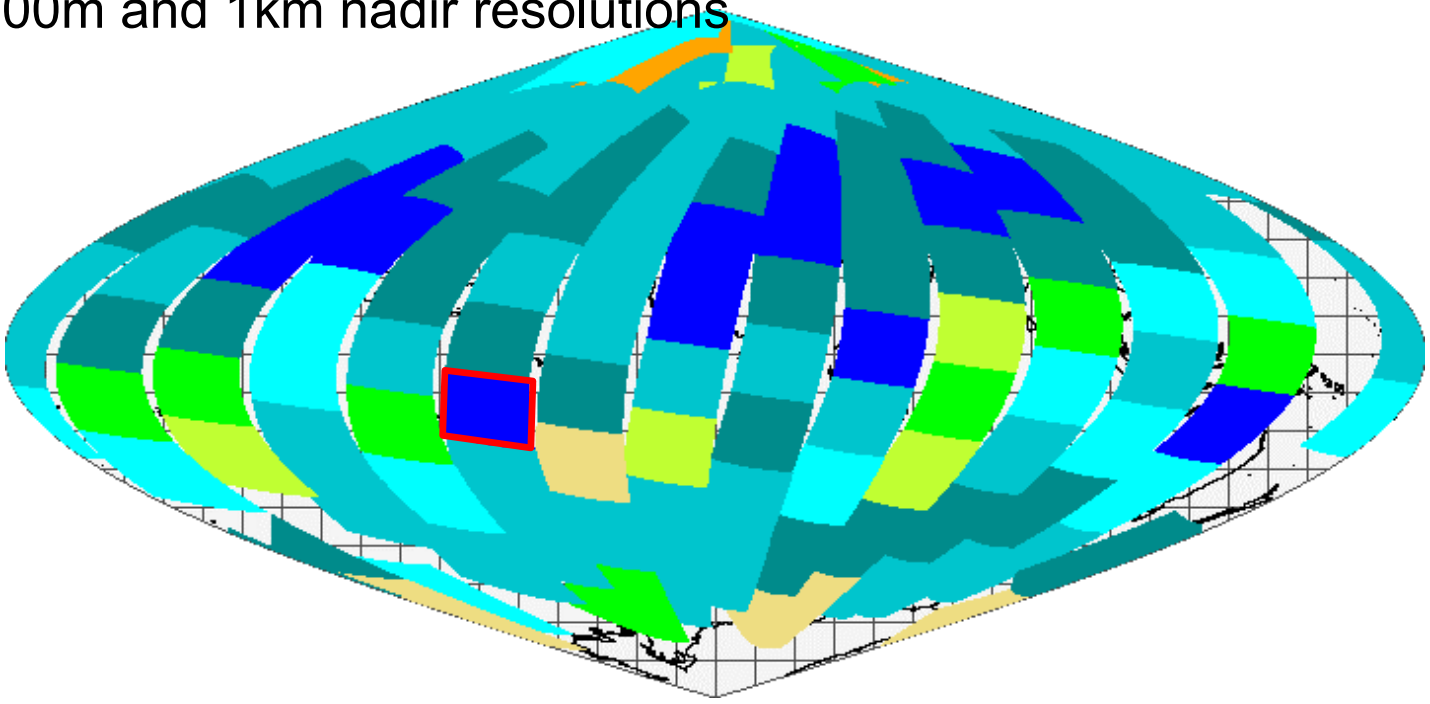
Validation "hierarchy" Definitions

- **Stage 1 Validation – Product accuracy has been estimated using a small number of independent measurements from selected locations and time periods.**
- **Stage 2 Validation – Product accuracy has been assessed by a number of independent measurements, at a number of locations or times representative of the range of conditions portrayed by the product e.g. EOS Land Validation Core Sites, Fluxnet sites, Aeronet sites.**
- **Stage 3 Validation - Product accuracy has been assessed by independent measurements in a systematic and statistically robust way representing global conditions e.g. IGBP DISCover Project – suggest that this be undertaken**

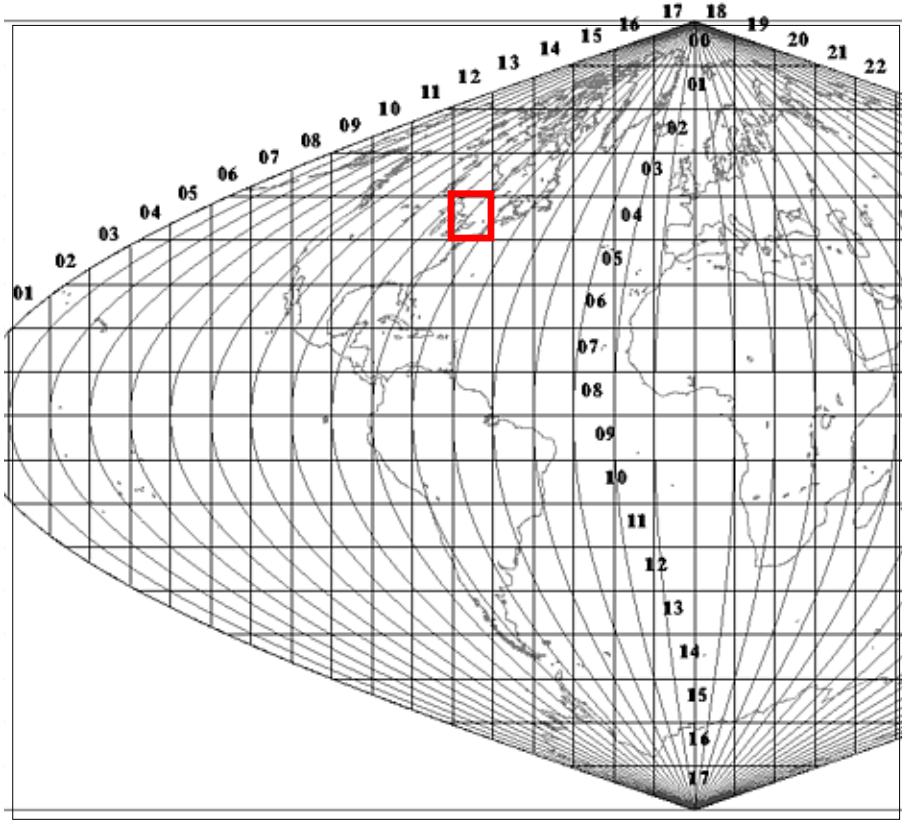
- **NB. need to make sure users are familiar with these definitions**
- **Validation results must be published and appropriate data available**

Level 2 Products

- **Retrieved geophysical parameters at the same location and in the same format as the MODIS Level 1 instrument data**
- **Size**
  - 288 granules/day; 5 min.; approx. 2340 x 2030 km
  - 250m, 500m and 1km nadir resolutions



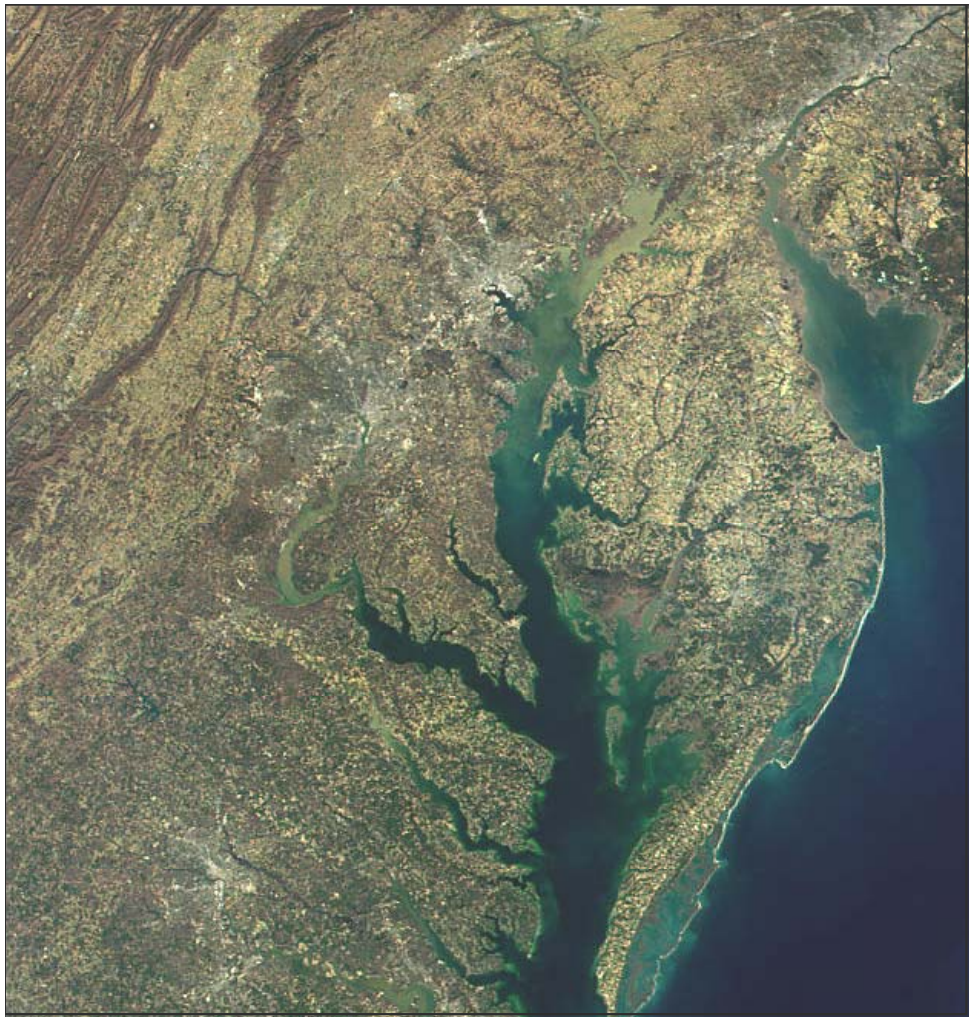
Level 2G, 3 and 4 Products



- **Level 2G/3: earth-gridded geophysical parameters**
- **Level 4: earth-gridded model outputs**
- **10 x 10 deg. Tiles:**
  - SIN (equatorial);
    7.5, 15 and 30 arcsec. resolution
    (roughly 250m, 500m and 1 km)
  - LAEA (sea-ice products, polar projection)
- **Global climate modeling grids; 0.05 and 0.25 degrees; lat/long grid**
- **Daily, 8-day, 16-day, monthly, 3-month, 6-month and yearly products**
- **Global Browse Products**

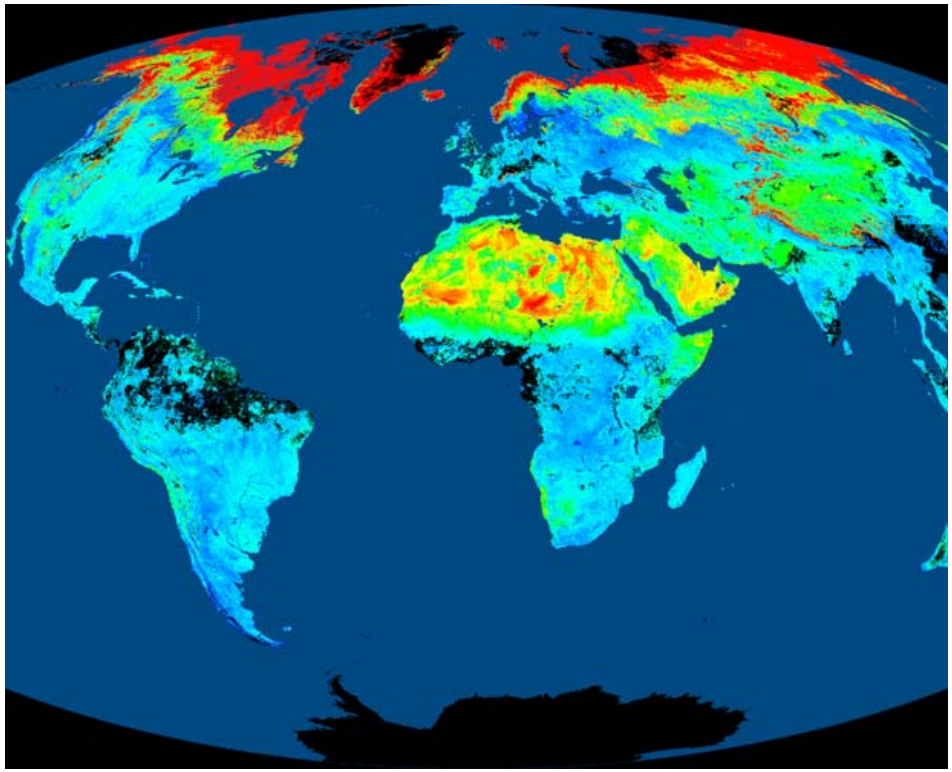
Surface Reflectance/Atmospheric Correction Products

- Reflectance corrected for gaseous and aerosol scattering and absorption, surface adjacency effects caused by variations in land cover and atmospheric/surface coupling effect
- Building block for generation of a number of land products: VI, BRDF/Albedo and LAI/FPAR



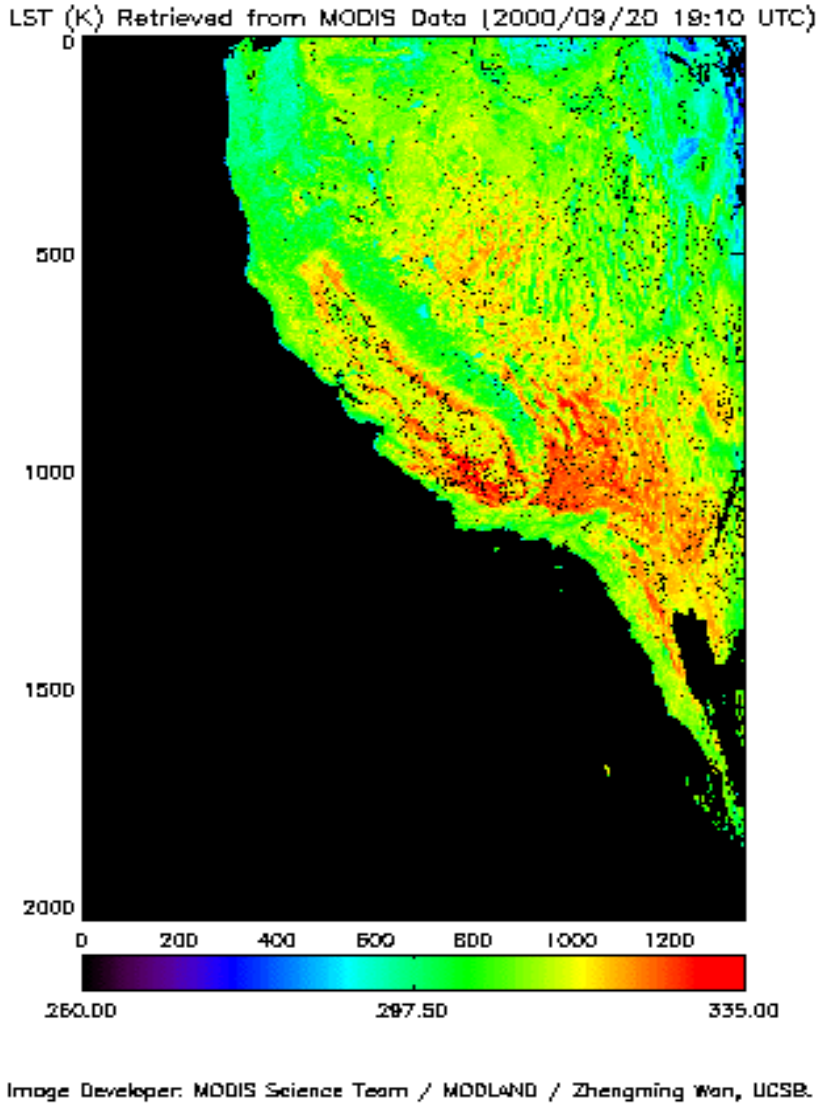
BRDF/Albedo

- **Provides global measures of albedo, BRDF adjusted surface reflectance and surface anisotropy**
- **Inputs**
  - Gridded Surface Reflectance
- **Outputs**
  - Albedos
    - Bihemispherical (white-sky)
    - Directional hemispherical (black-sky) albedos local solar noon
    - 7 Spectral and 3 Broadband Albedos
  - Nadir BRDF-adjusted Reflectances (NBAR)
    - 7 Spectral bands at mean overpass solar zenith angle
  - BRDF kernel weights in 7 spectral bands



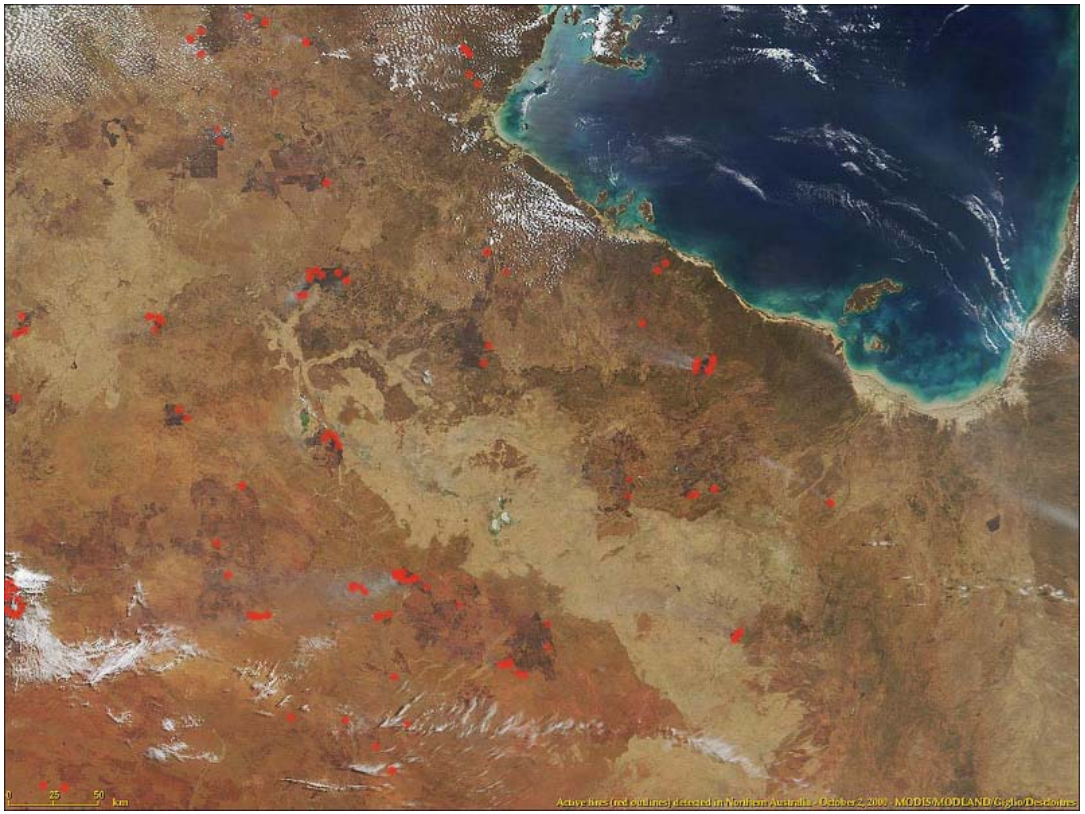
Land Surface Temperature (LST) and Emissivity

- Split-window and statistical regression techniques are used
- Input for studying the energy balance at the Earth's surface and the greenhouse effect
- Useful for a variety of climate, hydrological, ecological and biogeochemical studies
- Applications use TBD



Fire and Thermal Anomalies

- **Active fire products Identifies the location, timing and energy of fires**
- **Burned area estimation and for use with global models (post-launch product)**
- **Near-real time alerts of volcano and fire activity (RR product)**



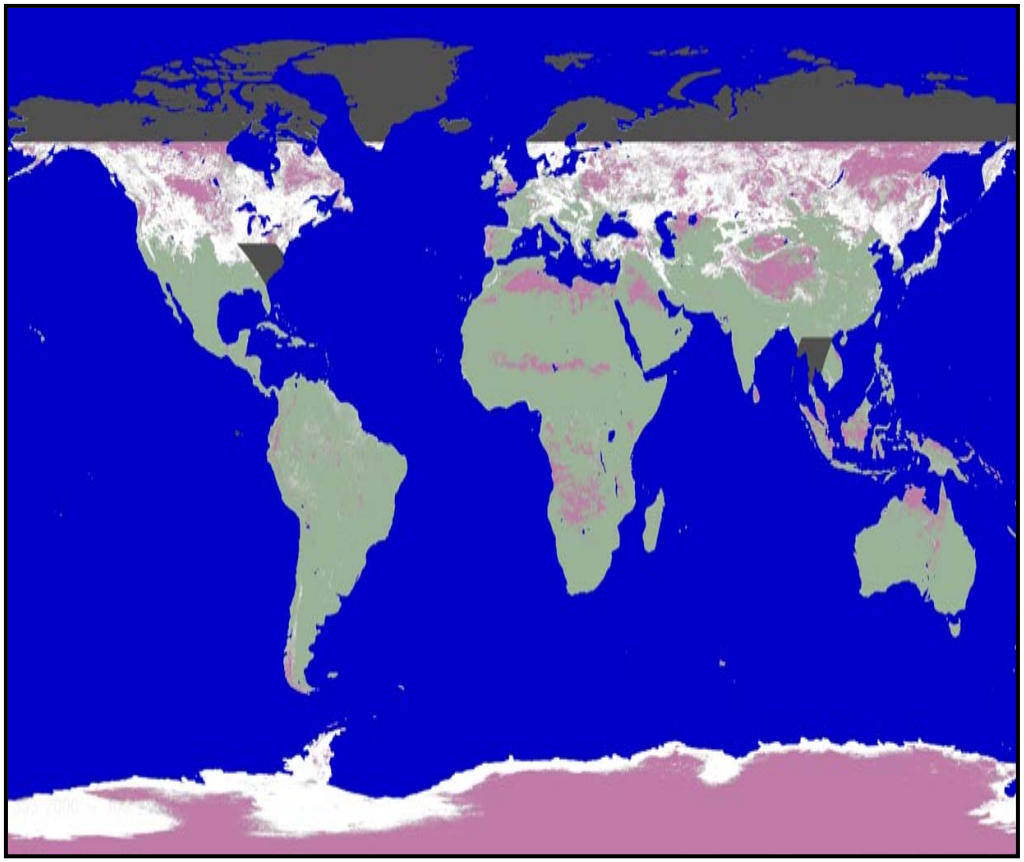
Snow and Ice Cover

- **Snow is mapped with an accuracy that meets or exceeds the accuracy of NOAA's operational snow maps (IMS and NOHRSC products)**

- **Improved accuracy of the interannual variability in snow cover a goal – decrease in N. Hemisphere snow cover**

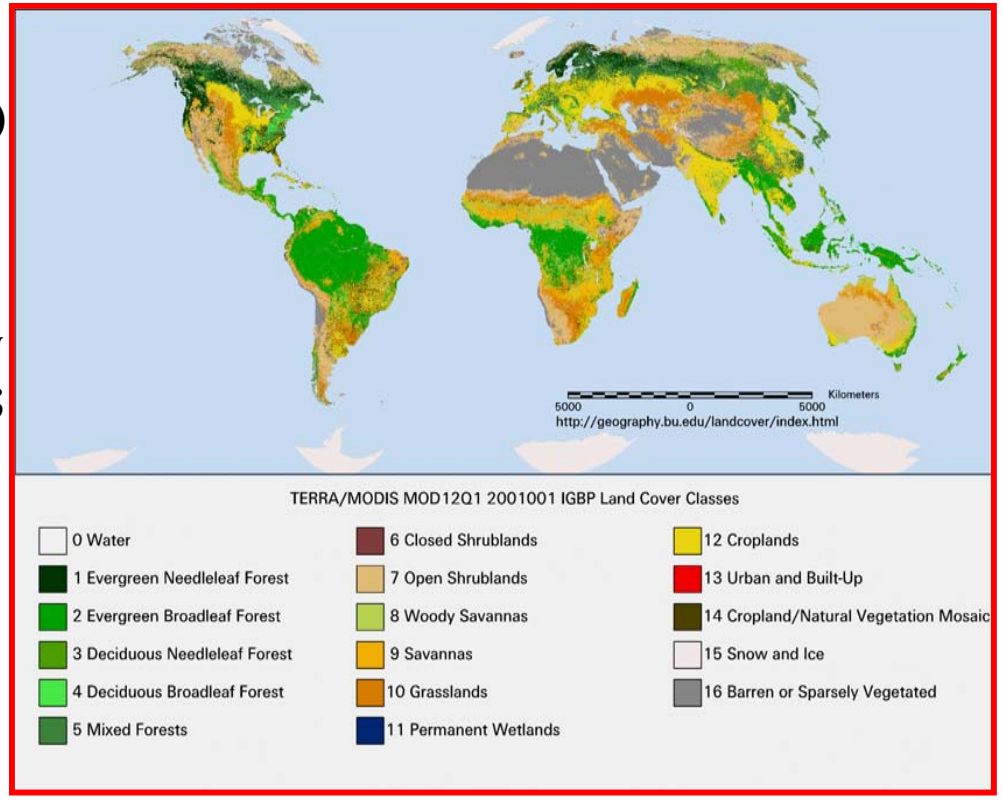
- **Improved cloud/snow discrimination**

- **Sea-ice new product being evaluated**



MODIS Global 1-km Land Cover

- **Land Cover Product**
  - •input for climate and BGC models
  - **•Inputs View-angle corrected (nadir) surface reflectance (NBAR), 7 land bands**
    - **Spatial Texture from 250-m; enhanced vegetation index; snow cover; land surface temperature; directional information**
  - **Outputs - Optional Class Schemes**
  - **Classification Confidences**
- **Vegetation Dynamics Product**
  - **•Global Phenology**
  - **•Change Vector Approach**



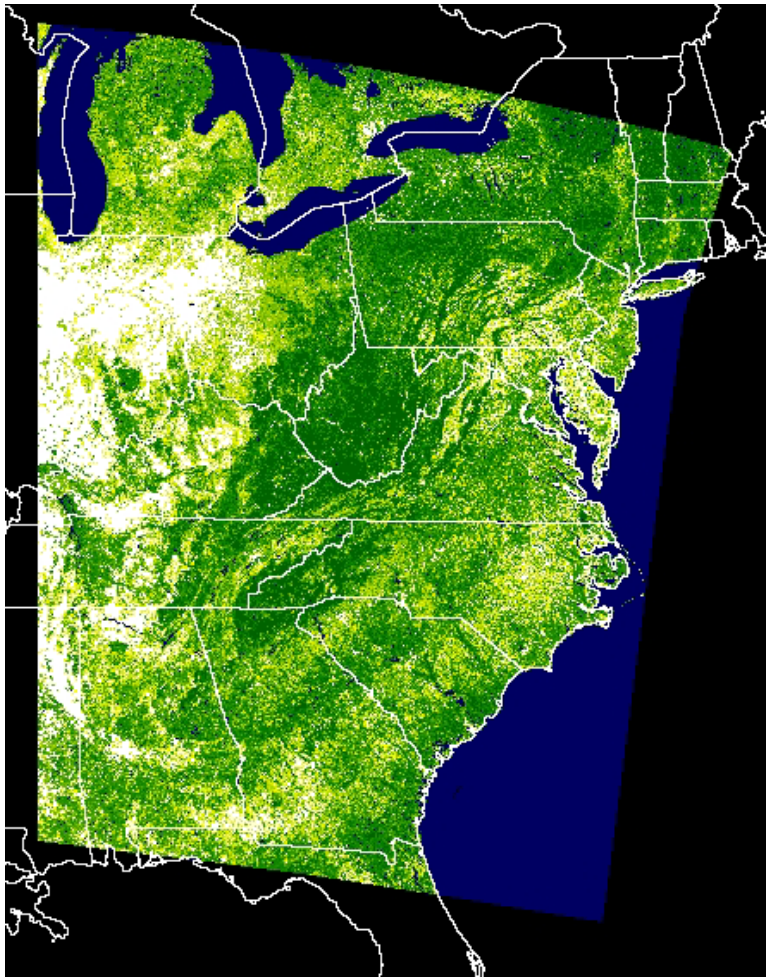
Vegetative Cover Conversion and Continuous Fields

Vegetative Cover Conversion

- Detects and labels changes in land cover
- Uses the 250m Surface Reflectance products

Vegetation Continuous Fields

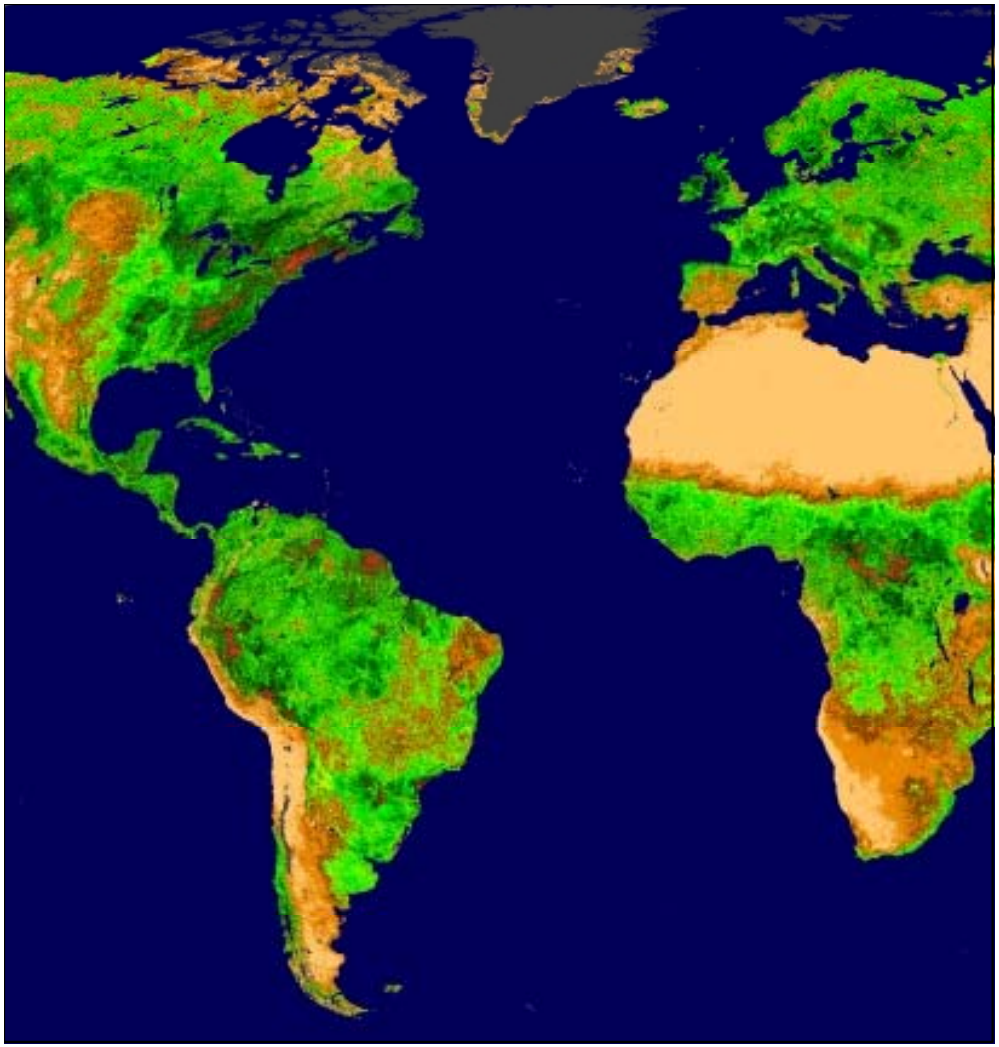
- Percent cover for basic land cover types
- Post-launch product



Vegetation
Continuous Fields

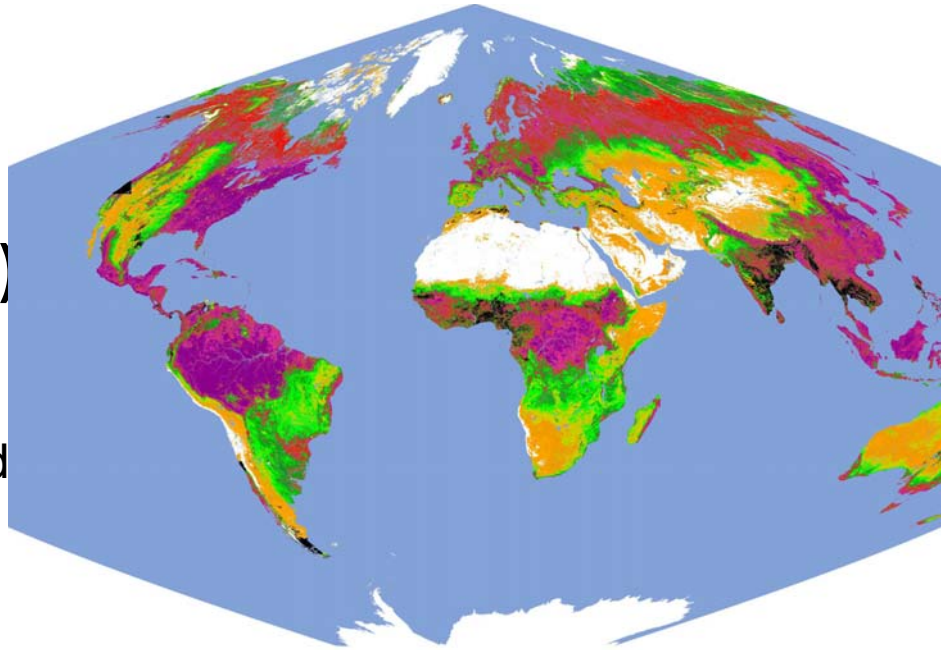
Vegetation Indices

- **Used for global monitoring of vegetation conditions**
  - Normalized Difference Vegetation Index (NDVI) and an improved Enhanced Vegetation Index (EVI)
  - EVI uses self-correcting atmospheric and soil calibration factors
  - Play an important role in the derivation of the land cover and land cover change, FPAR, LAI, and thermal products



LAI and FPAR

- **Leaf Area Index (LAI) and Fractional Photosynthetically Active Radiation (FPAR)**
  - LAI defines an important structural property of a plant canopy which is the one-sided leaf area per unit ground area
  - FPAR measures the proportion of available radiation in the photosynthetically active wavelengths (400 to 700 nm) that a canopy absorbs



GPP and NPP

- **Aimed at addressing carbon cycle questions**
- **GPP**
  - **8 day Net photosynthesis/Gross primary production**
  - **Available since June, 2000 at EDC**
- NPP
  - **Annual Net Primary Production Available for 2001 and 2002 at NTSG**
  - **not yet released for public**